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Forty-eight sentences, which associated eight attributes with six chessmen, were clustered in paragraphs by chessman, by attribute, or by rote group (randomized). One-half of 42 high school graduates were told the conceptual structure of the passage before reading. Subjects read the passages for three 5-minute periods in order to learn the information and to evaluate chess play. Free recall was required after each reading. With the organized passages, recall was about 50 per cent higher than with the rote group, but the rote group showed as much clustering (78 per cent) as one of the organized passages. Conceptual preinformation improved performance as trials increased but did not influence recall clustering. Primacy effects were obtained for the organized passages. Application test scores, although in the same direction as recall scores, did not differ significantly. Application scores correlated only with recall of the attributes concerning how the chessmen move. References and tables are included. (MD)

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Abstract

Forty-eight sentences, which associated 8 attributes with 6 chessmen, were clustered in paragraphs by chessman, by attribute, or randomized (rote group). One-half of 42 high school graduates were told the conceptual structure of the passage before reading. Ss read the passages for three 5 min. periods in order to learn the information and to evaluate chess play. Free recall was required after each reading. With organized passages, recall was about 50% higher than for the rote group, but the rote group showed as much clustering (78%) as one of the organized passages. Conceptual pre-information improved performance as trials increased, but did not influence recall clustering. Primacy effects were obtained for the organized passages. Application test scores, although in the same direction as recall scores, did not differ significantly. Application scores correlated only with recall of the attributes concerning how the chessmen move.

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Paragraph Organization of Written Materials: The Influence of Conceptual Clustering Upon the Level and Organization of Recall

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What do we mean by an "organized" reading passage? How does organization and information about the conceptual dimensions of a passage influence the level and organization of what Ss (subjects) recall after reading a passage? The present paper explores these questions, which are becoming more prominent as the experimental study of learning from text increases.

We may consider a series of sentences, each of which expresses an association between a concept name and an attribute of that concept, in terms of a two-way table in which the marginal entries (names of concepts and names of attributes) define the structure of the information. The categories (names of concepts and attributes) would be superordinate in this analysis, and the content would be defined by the entries in the cells of the table. The reader may wish to refer to the experimental passage, schematized in Table 1, as an example. Sentences are thus considered to represent a basic associative unit, and their assertions provide a unit for the analysis of organization and recall.

The associative structure of verbal materials has been explored by Johnson (1967), who has dealt with the distributions of verbal associations elicited by physics terms as a function of subject matter constraint. But it is clear that a set of sentences, which describe certain concepts, may be grouped in a variety of ways for instructional purposes. Such grouping or category clustering refers to the paragraph or topical organization of the stimulus passage. For instance, consider the following four sentences.

The Pawn is worth one point.
The Bishop is worth three points.
The Pawn moves in a forward direction.
The Bishop moves in a diagonal direction.

These sentences describe the point value and how the Pawn and Bishop move. They are grouped according to attributes--point value and moving capability. The sentences might also have been arranged in the following two ways.

The pawn is worth one point.
The Pawn moves in a forward direction.
The Bishop is worth three points.
The Bishop moves in a diagonal direction.

The pawn is worth one point
The Bishop moves in a diagonal direction.
The Pawn moves in a forward direction.
The Bishop is worth three points.

The second example is grouped according to chessman. The last example is only partially organized, and the reader is confronted with a new name and a new attribute on the second sentence. The last arrangement thus exhibits a higher degree of synchrony--a successive sentence can refer to a different concept and a different attribute. It is clear that the organizations shown in the first two examples, represent sequences of sentences which correspond to the conceptual dimensions which are expressed by those sentences. One category, either the name or attribute, is exhausted before a new category is introduced.

The sequence of sentences which occur in a passage, or which Ss produce from free recall, reflects the conceptual constraint which the writer has imposed upon the material. If we code those sentences according to which name or attribute they refer, and list them sequentially as they occur in the written material, we may count the number of consecutive sentences which make reference to a particular name or attribute. A ratio of repetition, or category clustering, can then be computed for these categorical units (cf. Bousfield, Cohen, & Whitmarsh; 1958). This index could be used to determine the clustering of categorical information for a reading passage and also for Ss' free recall protocols which result from reading the passage.

The present study explored the consequences of three different clusterings of sentences about chessmen, which correspond to the examples given above. For one passage, each paragraph described all attributes of one chessman. For another passage, each paragraph described one attribute for all chessmen. For the last passage, the sentences were arranged so that consecutive sentences contained information about different men and different attributes. Such a disorganized or rote passage would exhibit a high degree of synchrony, and in paired-associate learning a high degree of synchrony has been shown to be an inefficient instructional strategy (Wulff & Stolurow, 1957). A primary variable involved in paragraph structure is the sequencing of conceptual information, however, research on sequence constraints (e.g., Detambel & Stolurow, 1956; Anderson, 1966) has been derived mainly from studies which differ markedly from the concept definition task which confronts the reader of prose material. Some initial conjectures can be made, however. In comparison to a synchronous or rote passage we would expect both name and attribute organizations to produce better recall. The recall clustering of Ss who read a rote passage might also be lower than the groups reading the more organized passages. Evidence to suggest a difference between the two well organized passages on either amount or organization of recall is lacking.

Within the context of the present analysis we may explore the use of the superordinate categories as "organizers" (Ausubel, 1963) which should facilitate acquisition of the passage. The names of attributes or concepts, which define the structure of the verbal associations to be learned, would serve the purpose of providing categories within which to group subordinate content. Facilitative effects of providing such categories would be consistent with Miller's (1956) "chunking" hypothesis. Scandura and Roughead (1967) found that conceptual recoding cues (adjectives) can facilitate short-term memory for noun lists, and some concept learning studies (Duncan, 1965) suggest that information about the general parameters (number, arrangement) of verbal stimulus materials may also aid learning.

Method

Subjects

Forty-two female high-school graduates with a mean age of 22 (all clerical employees from the Bell Telephone Laboratories) served as Ss. None of the Ss had played chess previously. Subjects were assigned to experimental groups according to a table of random numbers.

Materials

The conceptual dimensions of the passage are described in Table 1. There were 48 cells in the table (six men and eight attributes). An attempt was made to keep the sentences describing each attribute relatively constant in form for

each chessman. For instance, a paragraph describing the number of squares the men can move began, "A Pawn may move only one square in one direction on each move. A Bishop may move any number of squares in one direction on each move.", etc. A paragraph describing how the men move began, "Pawns normally move forward on the chessboard. Bishops move diagonally (in any direction) on the chessboard.", etc. For all except one attribute the names of the chessmen occurred in the first part of each sentence.

Insert Table 1 about here

The 48 sentences resulting from Table 1 were grouped in three ways. The attribute passage consisted of eight paragraphs, each about a separate attribute. The sequence of sentences in the passage corresponds to reading across the top row of Table 1, then across the second row, etc. The name passage consisted of six paragraphs each containing all the attributes of one chessman. The sequence of sentences for this passage corresponds to reading down the first column of Table 1, then the second column, etc. The rote passage was constructed by randomizing all 48 sentences.

It is possible to express the organizational properties of the passages in numerical terms. If we code the rows by the numbers 1 to 8 (the sentences which are produced from these rows would be coded with the same number), we may write a 48-digit number representing the sequence of attri-

bute sentences within each passage. By counting the number of times a digit is repeated consecutively (R) and dividing by the total number of sentences (T) -- minus the number of concept categories used (K) -- we can express the amount of attribute clustering in the passage. For instance, the sequence 1,1,1,2,2,3,3, includes two repetitions of 1, one repetition of 2, and one repetition of 3. There are three categories, therefore the index of clustering $=(R/(T-K))\times100$ $=(4/(7-3))\times100 = 100\%$. A similar index can be computed for name organization. 'K' is subtracted from the total because the first item mentioned about each name or attribute cannot be a repetition. The index thus indicates that, when more than one response was given in the name or attribute categories, a certain percentage of those responses occurred consecutively.

The percentage of organization by attribute for the three experimental passages was 0% (name), 100% (attribute), 13% (rote). For name organization the percentages were 100% (name), 0% (attribute), and 5% (rote).

Each experimental passage consisted of either four or five pages of typewritten material, double-spaced on $8\frac{1}{2}\times11$ paper. The first two pages consisted of instructions and a verbal and diagramatic description of a chessboard with an example of what was meant by an "L-shaped move, diagonal direction," etc. The terms which were necessary to understand the attribute values of the subject matter were thus supplied before reading the passage content.

There was one additional page included in the passages for groups informed about the structure of the content. This page told Ss that they were going to read about six chessmen and their attributes. A list of attribute categories then followed, e.g., "Whether the man is a chesspiece. How many points it is worth.", etc. The names of the chessmen were not given. The final two pages contained the reading passage (420 words).

A 30-item true-false test was constructed which required Ss to indicate whether a series of moves and captures was possible within the rules of chess. No questions asked for specific verbal information included in any single sentence of the reading passage.

Procedure

Subjects were run in groups of three, seated in separate experimental booths. The following instructions, which describe the task, were handed to Ss at the start of the session. Subjects were allowed 8 min. to study these instructions and the definitions of terms.

"We would like you to learn the characteristics of the different chessmen. I will give you a reading passage about the men, and then after five minutes I will ask you to write down what you have learned. You will be given six minutes to write. You will then be given two more five minute reading periods, followed by writing for six minutes after each reading period.

After the reading, I will ask you to evaluate some chess play and to indicate something about the chessmen. This will be a 30-item true-false exam. For every answer you get right above chance (15 right), I will give you 50 cents. You can thus win $7.50 if you learn the differences and similarities among the chessmen, and also how to apply this knowledge."

Subjects were asked if they understood the direction and nature of chess moves before proceeding. The introductory material, which included categorical information for the groups informed about the structure of the passage, was then removed. The Ss were allowed to take notes during reading.

Subjects were told when to begin reading and when to stop at appropriate intervals. Notes and passages were removed during the free-recall periods. For recall, the following instruction was given; "Write down everything you can recall from the reading passage. This will help you on the final test. You needn't use complete sentences." Time allowed for writing was adequate for all Ss.

Free recall protocols were scored as follows. Any sentence, in order to contain information relevant to the passage content had to assert a relationship between a name and attribute value and thus could be coded according to which name and attribute it referred, and whether the association was correct.

These sentences were listed sequentially in the order in which S had written them, the sentences were coded, and the index of organization was computed. All sentences were included in the computation of organization regardless of the correctness of the assertion made. The only written assertions which were not direct statements about individual cells arose from statements such as, "All the men except the Pawn are chesspieces." Such cases, which were infrequent, were considered equivalent to a list of assertions between the attribute "chesspiece" and all the names of the men. They were recorded accordingly. The author and a clerical assistant independently scored the Ss' protocols on both name and attribute organization for each of the three trials. The average interrater reliability was .93, and in no case was below .90.

Design

The between groups analysis consisted of a 2×3 factorial design. Factor 1 was whether Ss were informed about the superordinate structure or uninformed. Factor 2 was passage organization; name (N), attribute (A), or rote (R). The dependent variables were free recall scores, free recall clustering, and application test scores.

Results

Recall

Analysis of the total number of cells in Table 1 which were correctly recalled (48 maximum) revealed a

significant effect of organization; F = 8.67, df = 2/36, $p < .005$. The means for groups A,N,R were 23.98, 22.5, and 15.57, respectively. Groups A and N differed from Group R, but not from each other (Duncan's multiple range test, using the .05 level of significance).

Significant learning took place across trials; F = 74.38, df = 2/72, $p < .001$. Although the effect of structural information was not significant (F = 3.80, df = 1/36, $p < .1$), there was an interaction between this information and trials; F = 4.66, df = 2/72, $p < .025$. Figure 1 indicates that structural information had a cumulative effect upon

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Insert Fig. 1 about here
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learning. Evidently, knowing some of the categories was increasingly helpful as more information was acquired.

The rank order correlation (rho, corrected for ties) between serial position of a sentence and probability of recalling that sentence was -.74 for Group A (t = 7.51, $p < .001$); -.46 for Group N (t = 3.51, $p < .01$); and -.28 for Group R (t = 1.82, $p > .05$). There were 46 df and a two tailed test was used. Although the sentence occurring at a given position might differ, it is clear that this general dependence upon sequential position was more pronounced for Groups A and N. For instance, the probability of recalling that a King is a chesspiece (sentence number 6) for Group A, was .55. For Group N, which encountered the same sentence in position 41,

the probability of recall was .24. This sentence occurred in position 29 for Group R, but the probability of recall was only .17. Figures 2 and 3 plot the percentage of Ss in Groups A and N who recalled each sentence in relation to the number in Group R who recalled that sentence. For instance, if seven Ss (50%) in Group A recalled a sentence, and none (0%) in Group R recalled that sentence, than 50% (50%-0%) would be the difference in recall. Figures 2 and 3 thus attempt to take into account the difficulty of each sentence by using Group R recall as a baseline. The general tendency for primacy

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Insert Figure 2 about here

Insert Figure 3 about here
---

effects in the better organized passages, seems apparent from the figures.

Two factors are required to account for the differential learning induced by the passages. First, conceptual organization, whether based on names or attributes, produced superior recall for Groups A and N. Second, sequential position of information was more influential in the well organized passages.

Clustering of Sentences in Recall

An important question is whether the groups, which differed in their ability to recall the passage accurately, also differed in their ability to reproduce the passage in an organized manner.

The average number of sentences followed by sentences in the same name or attribute category was 78.6% for Group A, 98.2% for Group N, and 79.4% for Group R; $F = 9.3$, $df = 2/36$, $p < .001$. The higher of the two clustering indices was used for each S, but the results are the same if both name and attribute categories are used and the number of repetitions (either category) are tabulated, or if the average of the two clustering measures is used. Multiple comparisons at the .05 level indicated that Group N was significantly higher than Group A or R, which did not differ from each other. Apparently, Group R, which had difficulties getting the information into memory, was able to organize that information according to the dimensions inherent in the passage.

There was no significant change in clustering over trials, nor did information about the structure of the passage influence clustering. Clustering was not correlated with amount learned nor with application tests scores (within individual groups nor for Ss as a whole).

The average clustering by name for Group N was 95%, for Group A 30%, and for Group R 51%; $F = 19.2$, $df = 2/36$, $p < .001$. Name and attribute clustering showed a high negative

correlation (since adopting one organizational pattern reduces the other), hence only name clustering is considered here. Clearly, Groups A and R reproduced more name clustering than the passage they had read. The A statistic (Runyan, 1968), comparing the deviations of Ss' clustering from the stimulus passage they read, indicated that the recall of both Groups A and R clustered more by name than did the stimulus passage; Group A, $t = 3.4$; Group R, $t = 4.8$: $df = 13$, $p < .005$. The clustering of Group N did not differ significantly from the stimulus passage ($t = .98$).

The raw data of Group N indicated almost no departures from complete name organization in recall. Because this introduced variance differences in the statistical analysis, several transformations of the data were tried, none of which influenced the results. To indicate the magnitude of constraint imposed upon recall organization in Group N, an analysis of variance was done using the deviation of each individual's clustering score from the mean of his group (Glass, 1967). The average deviation in name organization was 8.1 for Group N, 25.4 for Group A, and 34.5 for Group R; $F = 11.84$, $df = 2/36$, $p < .001$. Both Groups A and R differed significantly from Group N ($p < .05$), but not from each other. There was no change in conformity of organization across trials, nor was there any effect of structural information upon conformity. It seems clear that the name organization exerted strong control over the organization of recall.

Application Test

There were no significant differences among groups on the application test, although scores (corrected for chance) were consistent with recall differences; Group N = 11.43, A = 11.43, R = 8.29. The correlations between amount learned on trials 1 to 3 and the application test were .38, .38, and .35, respectively ($p < .05$, df = 40). Knowledge of only three attributes correlated with performance on the application test; the moves of chessmen ($r = .38$, $p < .05$), the way the men capture ($r = .44$, $p < .01$), and the number of squares the men can move ($r = .38$, $p < .05$) -- df = 40.

Discussion and Summary

Knowing the general structure of passage content aided learning, but this advantage was most evident as learning progressed. In the later stages of learning, when relatively large amounts of information were retained, the informed groups recalled 60% of the material, whereas the uninformed groups recalled 48%. The superordinate categories given to Ss in this experiment were also contained in the passage, and could be conceived as an outline. Since categorical information did not produce differences in learning on the first trial, it seems that such information did not merely relieve Ss of learning some of the content words, but rather it facilitated later acquisition, perhaps by providing an anchorage for additional information. The influence of these conceptual anchorage points, however, was not evident

in the clustering of recall. Structural information might thus facilitate higher level acquisition, yet not be reflected in Ss verbalizations. This inference is, of course, limited by the sensitivity of the clustering measure, and also by the nature of the materials.

It is important to note that the organization of a passage may produce substantial primacy effects. There was little or no advantage for either Group A or N in the latter portion of the passage, in spite of a large overall learning difference between these groups and the rote passage group. It is possible that, because organization was provided for Groups A and N, they tended to concentrate upon information within categories before going on. Paragraph organization might thus provide cues, by defining the limits of what must be learned, so that the reader can evaluate the extent of his learning. The primacy effect obtained in the present study is consistent with the findings of Deese and Kaufman (1957), although their material was about 1/4 the size of that employed in this study. A study by Rothkopf (1962), also with a smaller task than the present study, failed to yield primacy effects.

The clustering of recall for the rote passage group was not significantly lower than for Group A. Bousfield (1953) found that Ss will tend to cluster recall even if words are arranged in a random order. The present study confirms these organizational tendencies for categorically related sentences.

It was possible, in the present study, for Ss to select the sentences they responded to, and thus to control the sequence of sentencesthey read. It is likely that Ss considered the potential structure in the passage, even if they read the synchronous or rote passage. Several Ss in Group R remarked that they had looked for related sentences. The consequence of selecting related sentences would be to convert the rote passage into an organized one. Converting the passage into clustered inputs should reduce the primacy effects for Group R, it should detract from the amount of time devoted to learning (reducing recall), yet tend to aid recall clustering. In essence, these were the results of the present study.

Most text material probably falls somewhere between the extremes of paragraph organization used in the present study. The books of chess masters from which this information was drawn tended to mix discussion of chessmen and attributes, while interspersing incidental comments. If contiguity of related content is important, as this study suggests, then instructional techniques, which facilitate the selection of conceptually related sentences during reading should accelerate learning. For instance, color coding conceptually related sentences might overcome defects in some materials.

The amount of conformity among group members as to which organizational pattern to use for recall indicated that the Group N passage exerted the most constraint upon the organization of recall. Group N Ss had to associate

only one name with several attributes in each paragraph (1:N associations). Group A, however, was confronted with several names and possibly several values of one attribute in each paragraph (N:N associations). Group R was also confronted with several names and attribute values, but in addition the attribute categories might also change. Thus, the passage for Group N would represent the least amount of change from sentence to sentence and permit relatively direct classification of the sentences by concept name. The fact that the names always occurred in the first part of sentences might also have aided Group N clustering.

In terms of performance there was no relationship between the clustering of recall and amount learned. Groups A and R did not differ significantly in terms of recall organization, but Group A performed at a much higher level. It seems that poorly organized stimulus inputs, which interfere with learning, may not interfere with the organization of what is learned. The finding that organization of recall was fairly high in the rote group might have resulted because the implicit structure of the passage (names × attributes) was fairly obvious in the experimental passage.

In summary, appropriate paragraph organization of a passage relates to how well the sequence of sentences presented to Ss corresponds to the conceptual structure inherent in the material. Two alternate ways of organizing a passage, according to the structure expressed by the

sentences, were equally effective for learning, but they were not equally effective in producing a consensus on how the passage was organized in recall. A group which read the unorganized sequence of sentences showed poor recall, but the organization of what was recalled did not suffer appreciably. The advantage of pre-information about the conceptual limits of the passage was not immediately evident, but tended to manifest itself as more was learned.

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Table 1

Dimensions of Passages

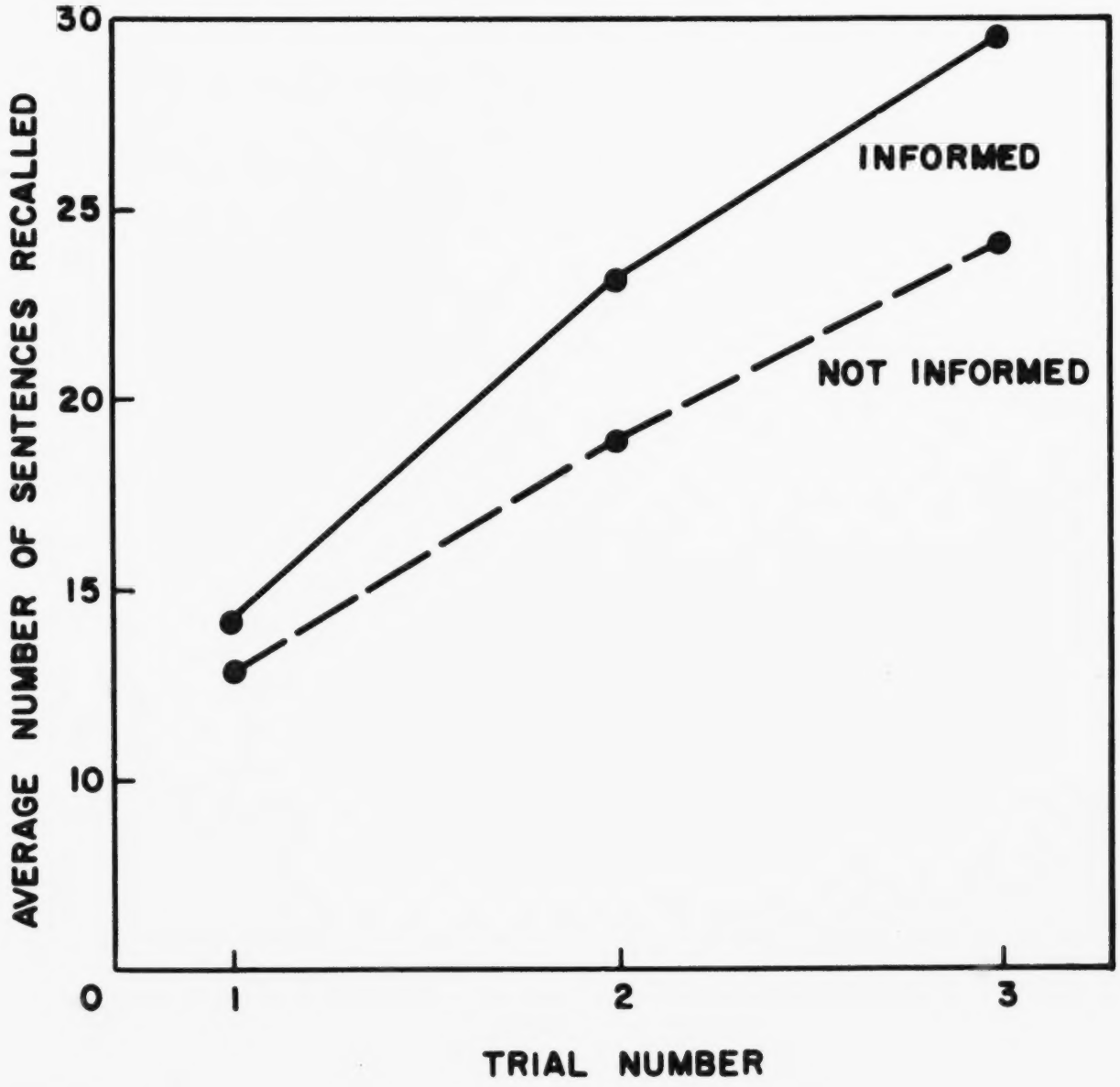
	Pawn	Bishop	Knight	Rook	Queen	King
Attributes						
Piece	is not	is	is	is	is	is
Points	one	three	three	five	nine	--
Number	sixteen	four	four	four	two	two
Color	½ white	½ white	½ white	½ white	½ white	½ white
	½ black	½ black	½ black	½ black	½ black	½ black
Moves	forward	diagonally	L-shaped	forward-backward left-right	forward-backward left-right diagonally	forward-backward left-right diagonally
Captures	diagonally	as moves	as moves	as moves	as moves	as moves
Squares	one	any number	three	any number	any number	one
Jumps	cannot	cannot	can	cannot	cannot	cannot

FIGURE CAPTIONS

Fig. 1. Effect of information about the conceptual structure of the passage upon recall.

Fig. 2. Difference between Group N and R in percentage of Ss who recalled each sentence. Sentences are given in the sequence in which they occurred for Group N. The sequence of sentences corresponds to reading down the columns of Table 1.

Fig. 3. Difference between Group A and R in percentage of Ss who recalled each sentence. Sentences are given in the sequence in which they occurred for Group A. The sequence of sentences corresponds to reading across the rows of Table 1.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0
1
2
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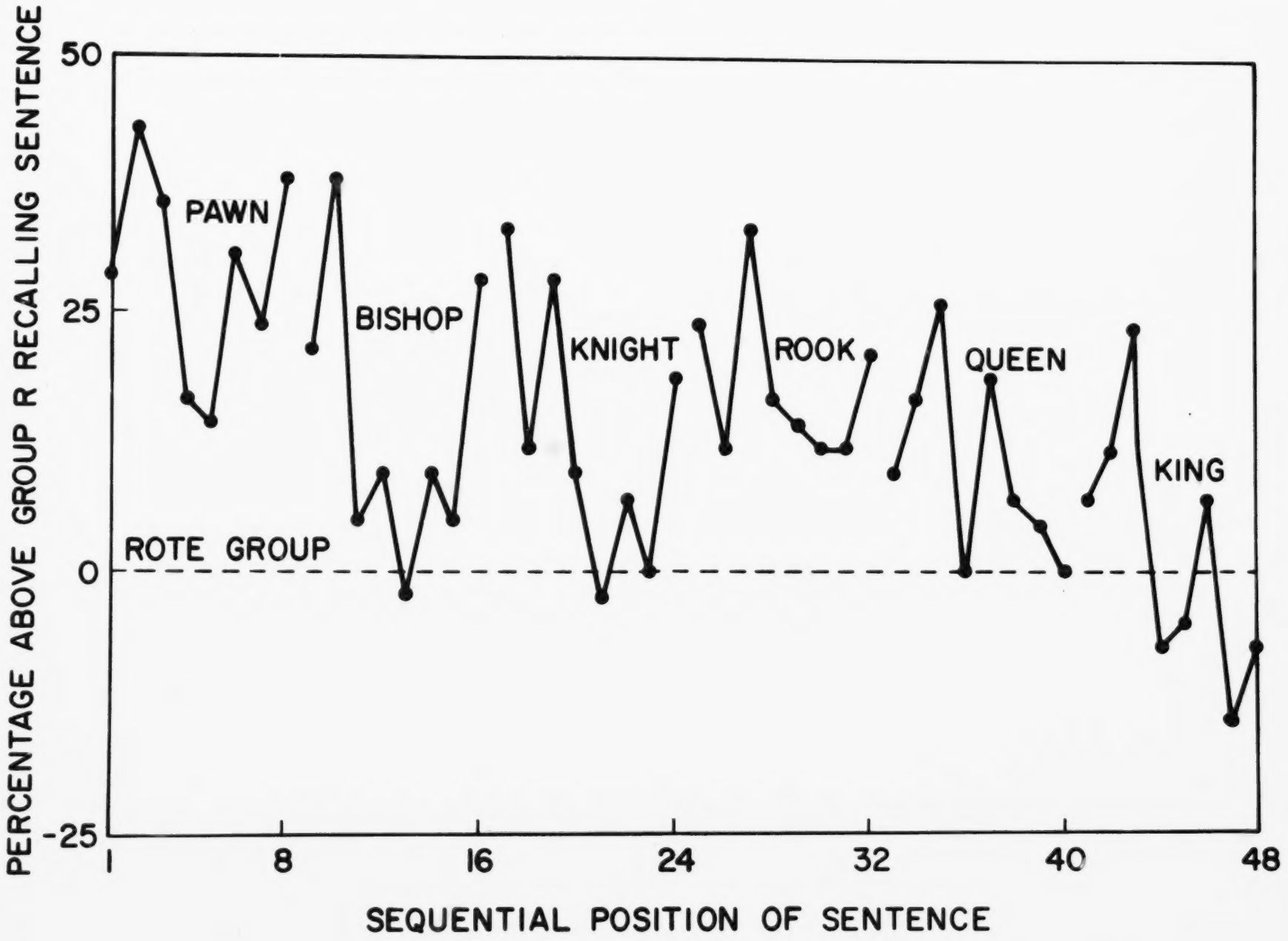
INFORMED
NOT INFORMED
TRIAL NUMBER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0
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32
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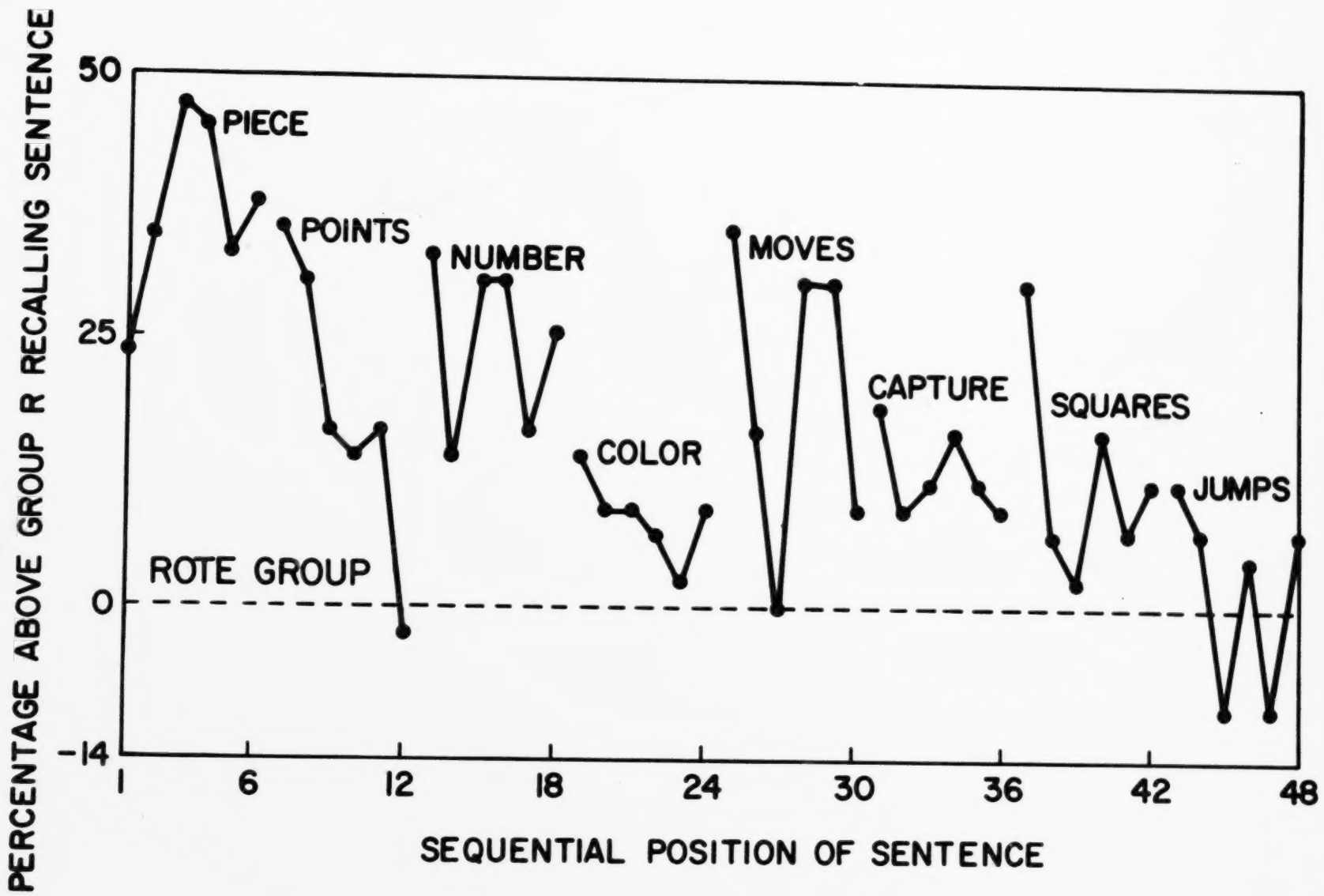
SEQUENTIAL POSITION OF SENTENCE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PIECE
POINTS
NUMBER
COLOR
MOVES
CAPTURE
SQUARES
JUMPS
1
6
12
18
24
30
36
42
48
SEQUENTIAL POSITION OF SENTENCE